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ELECTROMECHANICALLY ACTUATED PARKING BRAKE FOR MOTOR VEHICLES

Technical Field

The invention pertains to vehicle parking brakes and more particularly relates to an electromechanically actuated parking brake for motor vehicles.

Background of the Invention

An electromechanically actuated parking brake of this type is, for example, known from German Offenlegungsschrift DE 4,129,919 A1. Among other things, the aforementioned publication discloses a combination of an electric motor that acts as a motor operator and a drum brake. In this case, the electric motor is arranged in the vicinity of the associated wheel brake or forms one structural unit together with the wheel brake. However, this prior state of the art does not contain any reference regarding the specific design of the actuating unit.

Consequently, the present invention is based on the objective of proposing an electromechanically actuated parking brake of the initially mentioned type which has a high functional reliability and a small size, in particular, a small axial length of the actuating unit.

According to the invention, this objective is attained due to the fact that the rotor of the electric motor is realized in hollow or tubular fashion and radially encompasses the reduction gear.

According to one preferred embodiment of the invention, it is proposed that the reduction gear is realized in the form of a spindle drive, the spindle of which forms the power transmission element, and the spindle nut of which is connected to the rotor in power-transmitting fashion.

According to advantageous additional developments of the invention, the spindle drive may be realized] in a self-locking fashion. The first-mentioned solution automatically fulfills the legal requirements regarding currentless mechanical locking of the parking brake. However, an additional mechanical or electromechanical locking mechanism needs to be provided for spindle drives that are not realized in self-locking fashion, e.g., a ball screw.

In one particularly advantageous embodiment, the locking mechanism is formed by the armature of a magnetic clamp which can be displaced axially to the rotor. In the currentless state of the electric motor, this armature can be engaged with a friction disc by means of a spring,

wherein said friction disc cooperates with the rotor. In this case, the armature is preferably actuated by the magnetic leakage flux generated by the stator of the electric motor.

Another option for realizing the aforementioned locking mechanism consists of designing it in the form of an electromagnetic braking device that cooperates with the rotor.

Optimal power transmission between the power transmission element and the expanding lock is, according to another advantageous additional development of the invention, attained due to the fact that the spindle which forms the power transmission element is arranged such that it is secured from rotating.

One embodiment of the invention which can be inexpensively manufactured is characterized by the fact that the housing of the electric motor is realized in the form of a deep-drawn sheet metal part.

In order to sensibly realize the aforementioned arrangement for securing the spindle from rotating, another advantageous embodiment of the invention is characterized by the fact that the housing contains an axial tubular extension which protrudes into the interior of the rotor and accommodates the end of the spindle which faces the expanding lock such that it is secured from rotating, wherein said extension preferably has a polygonal inner profile that cooperates with the correspondingly shaped end of the spindle.

In another embodiment of the invention which can be inexpensively manufactured, the rotor is realized in the form of a tubular sheet metal part that forms the spindle nut of the spindle drive. In an alternative embodiment, a ball screw nut is pressed into the rotor.

In addition, it is proposed that the rotor is arranged in a fixed bearing on one end, wherein said fixed bearing is held in the housing of the electric motor by rolling up the rotor end.

It is also quite advantageous that the housing of the electric motor is closed by means of a bearing cover on its end that faces away from the drum brake. This bearing cover is fixed to the housing by rolling up. In this case, the bearing cover preferably accommodates a movable bearing, in which the other end of the rotor is arranged.

The bearing cover advantageously limits a hollow space that serves for accommodating an electronic circuit for controlling the electric motor. Due to this measure, the electronic circuit for controlling the motor is integrated into the motor housing.

In another embodiment of the invention which can be inexpensively manufactured, the bearing cover consists of plastic and contains a cable guide through which a preferably extrusion-coated connecting line extends.

A flawlessly functioning power transmission between the actuating unit and the expanding lock of the drum brake is, according to the invention, obtained by utilizing a short, flexible steel cable line that is pressed or crimped into the power transmission element and provided with a drawbar eye on its end that faces the expanding lock. In this case, the steel cable line preferably consists of a steel strand that is provided with a plastic sheathing. The steel cable line is provided with a bellows so as to prevent the admission of dirt into the electric motor, wherein the end of the bellows which faces away from the drawbar eye is realized in the shape of an O-ring and accommodated by a preferably circular depression arranged in the housing of the electric motor. The end of the bellows which faces the expanding lock is welded to the plastic sheathing, in particular, by means of ultrasonic welding, such that the bellows is reliably sealed and protected from the admission of dirt or moisture. The motor interior is reliably protected from moisture by crimping the end of the steel cable on the motor side into a conically extending blind bore of the power transmission element.

Electronically commutated DC electric motors or DC brush motors may, in particular, be considered as driving motors for the actuating unit of the parking brake according to the invention. These motor types are particularly suitable for generating high torques from a standstill.

In order to attain a significant reduction of the required driving torque to be generated by the electric motor, a planetary gear is functionally arranged between the rotor and the reduction gear, wherein the sun wheel of said planetary gear is realized on one end of the rotor. The planet wheels preferably cooperate with an internal ring gear formed on the inner side of the housing of the electric motor. In this case, it is particularly practical if the planet wheels are arranged on a radial collar of the spindle nut that cooperates with a radial bearing supported on the housing of the electric motor within its region that is situated adjacent to the collar.

An optimal and space-saving mounting of the actuating unit is, according to another advantageous embodiment of the invention, obtained by providing the housing of the electric motor with a constriction that serves for mounting the actuating unit by means of rolling up in a cutout of

a dirt trap that protects the drum brake from the admission of dirt. The drum brake is preferably realized in the form of a dual power brake.

Brief Description of the Drawings

Figure 1 is a first embodiment of the electromechanically actuated parking brake according to the invention in the form of an axial section.

Figure 2 is a second embodiment of the object of the invention, namely in the form of a representation that corresponds to Figure 1.

Figure 3 is a third embodiment of the object of the invention, namely in the form of a representation that corresponds to Figure 1.

Detailed Description of the Preferred Embodiments

Now referring to Figure 1, the electromechanically actuated parking brake according to the invention which is shown in the figures essentially consists of a generally known drum brake, preferably a dual power brake 1, and an actuating unit 2. The housing 3 of the actuating unit which is realized in the form of a sheet metal part is mounted in a cutout of a dirt trap 4 that protects the drum brake 1 from the admission of dirt and is not illustrated in detail in the figure. For this purpose, the housing 3 is provided with a constriction 26 that allows the rolling up of the edge region of the dirt trap 4 which limits the cutout. The actuating or driving unit 2 is connected to an expanding lock 5 in power-transmitting fashion. The expanding lock allows a mechanical actuation of two brake shoes, one of which is illustrated in the figure and identified by the reference symbol 6. When the expanding lock is actuated, the brake shoes 6 come in contact with a brake drum 7.

The actuating unit 2 consists of an electric motor 8, a reduction gear 9 and a power transmission element 10 that is coupled to the aforementioned expanding lock 5 by way of a steel cable line 14. The steel cable line 14 that preferably consists of a steel strand and a plastic sheathing that surrounds the steel strand is provided with a drawbar eye or a nipple on its end that faces the expanding lock 5. Its other end is pressed or crimped into the power transmission element 10 or 16, respectively. An elastic bellows 15 that is arranged between the electric motor 8 and the expanding lock 5 preferably serves for protecting the electric motor 8 and the steel cable line 14 from the admission of dirt. The edge region of said bellows which is assigned to the housing 3 is

realized in the shape of an O-ring and is arranged in a circular depression 25 in the housing 3, namely in such a way that it is clamped between the housing 3 and a carrier plate 27. The end of the bellows which faces the expanding lock 5 is welded to the plastic sheathing, in particular, by means of ultrasonic welding. Consequently, the steel cable line 14 is reliably sealed and protected from dirt and moisture.

The electric motor 8 shown in the embodiment according to Figure 1 is realized in the form of an electronically commutated motor, wherein said motor may also be realized in the form of a DC brush motor. The stator of the electric motor 8 which is identified by the reference symbol 11 is immovably arranged in the housing 3 that is of deep-drawn sheet metal, wherein the rotor 12 is preferably realized in the form of a tubular sheet metal part, onto the surface of which permanent magnet segments 13 are bonded. In this case, the end of the rotor 12 which faces the drum 7 is arranged in a fixed bearing 18 held in the housing 3 by rolling up the rotor end. A movable bearing 19 supports the end of the rotor which faces away from the drum 7. The reduction gear 9 is preferably arranged coaxially to the rotor 12 and radially encompassed by said rotor in this case.

Figure 1 also shows that the reduction gear 9 is realized in the form of a self-locking spindle drive, the spindle 16 of which forms the power transmission element 10, and the spindle nut 17 of which is formed by a tubular part that is arranged coaxially to the rotor 12 and preferably realized integrally with the rotor 12. An axial tubular extension 20 of the housing 3 which preferably protrudes into the interior of the rotor 12 serves for securing the spindle 16 from rotating. The aforementioned extension 20 has a polygonal inner profile that cooperates with the correspondingly shaped end of the spindle 16.

The housing 3 of the actuating unit 2 is closed with a bearing cover 21 that is fixed in position by rolling up the edge region of the housing 3. The bearing cover 21 which preferably consists of a suitable plastic material and accommodates the aforementioned movable bearing 19 limits annular hollow spaces 22 in the housing 3 of the actuating unit 2. Not-shown electronic components that serve for controlling the electric motor 8 may, for example, be arranged in this hollow space. In addition, a cable guide 23 is provided in the bearing cover 21. A preferably extrusion-coated connecting line 24 that leads to the stator 11 of the electric motor 8 extends through the aforementioned cable guide.

In the embodiment of the invention which is shown in Figure 2, the reduction gear 9 described previously with reference to Figure 1 is realized in the form of a spindle drive that is not self-locking or a ball screw 28, 29, 30, respectively. The ball screw consists of a threaded spindle 28 as well as a ball screw nut 29 that is preferably pressed into the rotor 12. The rotational movement of this ball screw nut is converted into a translational movement of the threaded spindle 28 by means of rows of balls 30. In order to prevent a loosening of the parking brake according to the invention, the ball screw 28-30 cooperates with a locking mechanism 31 that is formed by an armature 33 of a magnetic clamp in the embodiment shown. This magnetic clamp is actuated by the magnetic leakage flux generated by the stator 11 of the electric motor 8. The armature 33 that is preferably realized in cup-shaped fashion is arranged on the rotor 12 such that it is secured from rotating relative to said rotor. However, this armature can be axially displaced on the rotor and is pressed against a friction surface 34 formed on the aforementioned bearing cover 21 by means of a plate spring 32, while in the currentless state of the stator 11. Once the electric motor 8 receives a current, the armature 33 is retracted against the force of the plate spring 32 due to the effect of the leakage flux generated by the stator 11, i.e., the armature is disengaged from the friction surface 34 such that the rotor 12 is able to freely rotate and drive the armature 33. However, the scope of the invention also includes an embodiment in which an electromagnetic braking device is provided which cooperates with the rotor 12 and is actuated independently of the stator 11 receiving a current.

Figure 3 shows one additional embodiment of the actuating unit 2 used in the invention. In this case, the electric motor 8 is realized in the form of a DC brush motor, the stator of which is formed by permanent magnet segments 36 arranged in the housing 35 of the actuating unit. The rotor that receives a current by way of a collector 37 is formed by a tube 39 that is supported at two points and carries an armature winding 38. The end region of this tube which faces the drum not shown is realized in the form of a sun wheel 40 of a planetary gear that is identified by the reference symbol 50 and is functionally arranged between the electric motor 8 and a reduction gear 51. The design of the reduction gear 51 corresponds to that of the spindle drive shown in Figure 1, i.e., a detailed description of this reduction gear is not required. The sun wheel 40 drives planet wheels 41 that revolve in a ring gear 42. This ring gear is machined into the inner side of the housing 35 and consequently forms part of said housing. The planet wheels 41 are carried by a radial web 43

that is arranged on the end of the tubular threaded nut 44 for driving the spindle 45 which faces the [not-shown] drum brake. The web 43 is arranged in the housing 35 in a main bearing 46, i.e., it serves as the drive of the planetary gear 50. The entire driving or actuating unit is encapsulated, i.e., protected from the admission of dirt and moisture by means of seals 47 and 48.

The steel cable line 14 is pressed or crimped into the power transmission element that is realized in the form of a spindle 45 in order to additionally seal the electric motor 8, in particular, from the admission of moisture. For this purpose, a conical blind bore 60 is provided inside the spindle 45. The end of the steel cable line 14 is accommodated in this blind bore and secured from separating by means of crimping. In this case, the steel cable line with its plastic sheeting is inserted in the blind bore of the spindle during the crimping process, namely in such a way that a seal that is impermeable to moisture is formed between the plastic sheathing and the conical bore surface. Any moisture that might be present in the steel cable line 14, i.e., between the steel strand and the cable sheathing, consequently cannot be admitted into the interior of the electric motor.